Mobile Bandwidth Report, March 2013

Striking gold

Sunday afternoon, August 5, 2012. The Olympic Stadium in London erupts as Team GB wins another gold medal. But the triumphant athlete isn't in the Stadium at all. Instead it is the celebration of a victory more than ten miles away, on Wimbledon Centre Court. Andy Murray has just defeated Roger Federer to become Men's Singles Tennis Olympic Champion.

The reason such a huge spontaneous cheer goes up is that thousands of spectators in the Olympic Stadium are watching the tennis on BBC TV on smartphones or tablets. Not only is this moment a turning point in Andy Murray's tennis career (and he becomes a British winner, not a Scottish loser), it is also a turning point for the mobile industry. This is the peak of mobile usage in the Stadium during the Games. The Digital Olympics has truly arrived on to mobile devices, and mobile bandwidth has proved itself up to the massive volume that is being demanded of it.

To give some idea of scale, more data is carried to and from mobile devices in the UK on "Super Sunday" than during the entire FIFA 2010 World Cup in South Africa, a mere two years before. With growth happening at this kind of rate, questions about the nature and future of mobile bandwidth are central to the further development of the mobile industry.

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Utopia or dystopia

The stats for the Olympics are indeed impressive. For example,

- 12 million requests to the BBC for video on mobile
- Download speeds above 10 Mb/s achieved in full stadium
- 1,000 wifi hotspots in the Olympic Park

The Olympics produced an excellent mobile experience, and customers' expectations have risen. In the same way that Queen Elizabeth's coronation in 1953 was the first UK "TV event", which got people into the habit of wanting to watch TV, the "Digital Olympics" have got people firmly into the habit of wanting to watch video content on mobile devices. This should be great news for mobile operators, device brands, content creators, content aggregators, advertisers and everyone who sees opportunity in the mobile world.

But ... things that sound too good to be true usually are. The Games lasted two weeks, then another two weeks for the Paralympics. Investment in mobile bandwidth takes years to make a return, so the costs of the towers on the Olympic Park, the antennas, the backhaul fibres and the people to make it all work were not going to make money for the mobile and wifi operators. The operators recognised that the Games were a showcase for the whole of the UK and that their own reputations would be destroyed if the mobile experience fell short of expectations. It was an investment in risk management and "good citizen" engagement, not something led by a financial business case. This intensity of investment could not form the basis for a nationwide upgrade of mobile bandwidth.

What is more, the mobile operators in the UK have pressures from all sides: the economy is hard, competition is intense, regulation is still biting, revenues and profits are sliding, but usage volumes are rising. Operators can't continue to provide more for less, so something has to change. As the investment that operators put into mobile bandwidth is the largest capital spend they make, then it is clear that the future of mobile bandwidth is going to be at the heart of the future of mobile.

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What is mobile bandwidth

Mobile begins at home.

For those who have spent a lifetime working in the field of telecommunications, one of the remarkable developments over the last ten years has been the adoption into common parlance of industry terminology, particularly "routers", "Gigabytes" and "Megabits per second" (Mbps). broadband access to the home: the WiFi broadband box, the allowable volume of consumed data per month, and the bandwidth. Bandwidth is most helpfully defined as the speed of connection between a device and a web server, measured at the slowest part of the network, more of which later.

Those living in well-populated areas in the UK are offered home broadband by more than one broadband service provider at a bandwidth from 30Mbps to 100Mbps and beyond. For more rural areas, the government has set a Universal Service Commitment (USC) of 2Mbps to every home in the country. In January 2013, Ofcom's Strategy Director suggested that the minimum USC should be in the order of 8-10Mbps.

This reflects that fact that, bandwidth demand has increased well beyond 2Mbps since the USC target was proposed in 2009. Taking to one side the on-demand services offered directly by broadband service providers, this demand has largely been driven by three developments:

- terrestrial broadcasters have introduced HD versions of their catch-up TV programmes; the BBC, for example, recommends a bandwidth of 3.5Mbps for HD iPlayer

- several web-based technology companies, including Love Film Instant, Netflix and Sky's stand-alone NowTV, have large libraries of films and TV programmes which can be streamed to multiple rooms via game consoles, personal video recorders, Smart TVs and tablets

- each home now has an average of six devices connected to the internet via the WiFi router, including laptop, desktop and all-in-one personal computers, as well as iPods, Kindles, tablets and smartphones.

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Currently, the smartphone is the main type of device which regularly uses both the mobile network and its home broadband access. The home bandwidth available is usually dependent on the technical characteristics of the physical line connecting the home to the first aggregation point in the network: the "last mile" in colloquial industry jargon. Copper lines can support up to a maximum of around 50Mbps with a technology called VDSL, depending on the length of the copper line. Optical fibre lines have no such distance limitations and are technically constrained so that their bandwidth is limited, typically to 100Mbps.

By contrast, mobile bandwidth is not so constant, nor is it always a consequence of the "last mile". It is dependent on three parts of the mobile network. Firstly, the mobile network starts with the mobile device. Most mobile devices today contain at least two physical radios: 2G which was introduced between 1984 and 1994, and 3G which was deployed from 2000 onwards. Each had sub-species which increased the bandwidth, including acronyms such as 2G-EDGE , 3G-HSDPA, HSPA and HSPA+. Because of the technical characteristics of the spectrum used for each technology, 2G geographic coverage is usually greater than that for 3G, and 3G greater than 4G. As a result, 4G connections are allowed to fall back seamlessly to 3G, and 3G to 2G. The latest iPhone includes 4G, which either works today in certain places on EE's network and drops back to 3G and 2G elsewhere, or remains "4G ready" for the networks of Vodafone, O2 and Three UK later in 2013.

Secondly, the mobile radio access network connects the device, usually via a mobile radio base station that includes a number of very expensive line items: acquiring and renting sites, constructing masts, deploying antennae, cabling and power, housing radio equipment, and supporting thousands of sites. Each site costs many tens of thousands of pounds per year and is dependent on the geographical location of each site. Despite the cost, the mobile radio access network is often the slowest part of the network.

If one mobile radio base station is connected to only one device, then that device could use all the bandwidth of the mobile radio access network that is reserved for internet access. As more devices connect, the available bandwidth per device decreases. To overcome these capacity limits, operators deploy ever-smaller base stations. The smallest are currently called femtocells, which sit inside homes or offices and connect back to the core network over fixed internet broadband.

Thirdly, the backhaul network connects mobile radio base stations to the core network. This has not usually been the slowest part of the network, but as the bandwidth of the mobile radio access network has increased it is becoming so in some cases. This tends to be in areas of light population where, ironically, each device would otherwise get a higher level of bandwidth than in urban areas because the mobile radio access network is under-utilised. In February 2013, Strategy Analytics published a report predicting that over the next five years the slowest part of the network will be the backhaul network in many places, and that a multi-billion dollar investment worldwide was required to rectify this.

For completeness, beyond the backhaul network is the core network, containing core network bandwidth and network control functions. The core network is the cheapest part of the network. The Chinese vendor Huawei was the first to demonstrate just how cheap when in 2008 it drove a single fifty foot truck around all the UK mobile companies containing a core network which could support millions of customers. However, in some respects it is the most important part of the network. On the rare occasion when there are major customer problems, faults in the core network are usually to blame and that is because the network control functions are much more complex than that required for home broadband; they includes features such as mobile phone authentication, encryption of mobile communications to prevent eavesdropping, support of roaming when abroad, billing for both pre-paid and post-paid customers and enforcement of fair use policies. Because the core network is the only part of the mobile network where catastrophic failure can occur, it is the most highly engineered.

4G to the rescue?

The Olympics have pushed the fast-forward button on consumers starting to watch video via permanent streaming of full content (eg BBC iPlayer), rather than by short downloads of highlighted or "snacksize" clips, all of which will put further pressure on the existing capacity in the mobile networks.

Mobile networks need a combination of more capacity and faster data speeds. This double benefit is provided by 4G. As the name implies, 4G is the technology for the next generation of mobile services after 3G. When it was conceived around 2005, it was seen as a long-term evolution of mobile services, hence its other acronym, LTE. It is a set of technical standards, designed particularly with the efficient communication of mobile video and other high-speed data in mind.

Mobile operators are already live with 4G services in many other countries and the UK in February 2013 auctioned off licences for radio spectrum to be used for 4G. We have already explained that mobile base stations are expensive. The demand for lots of 4G capital expenditure means that operators will be cautious about rolling out 4G coverage quickly. What we'll see instead is "oasis" coverage, as we did with 3G rollouts, with shopping centres, airports and other densely-used areas covered first. The realities of rollout mean that it will be a number of years before the promised 4G experience is the typical mobile experience.

The growth of the "frenemy"

To reduce of the "radio layer" for 4G, mobile operators have persuaded regulators to let them share their network infrastructure and instead to concentrate on competition for the retail branded services to end-customers. So Vodafone and Telefónica O2 are friends in their joint venture to build future networks, but enemies as they continue to compete for every consumer's business. This is good news for end- customers, as it will lower costs and speed up rollout, but it can spell bad news for already hard-pressed network vendors and, especially, for innovation by vendors. The vendors will have fewer network customers to sign up, and those customers will have stronger negotiating strength.

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Pricing for finite bandwidth

No matter how you look at it, mobile bandwidth is finite, especially the "air interface" between the device and the network antenna. It is also less powerful than an optical fibre broadband network. You can add more antennas, you can upgrade and manage the network in very sophisticated ways, you can cleverly swap between 3G, 4G, WiFi and other wireless technologies (so-called HetNets), but there's no escaping the physics: the radio waves in the air can carry less data and fewer calls, and they carry them less reliably and for a shorter distance, than a laser beam shooting along a glass wire in an optical fibre network.

A mobile network carries small packets of data and minutes of calls by the billion. But, because it is finite, there will be times when there is congestion – just like an extreme rush-hour on even the widest road. If nobody tries to manage this, then all the traffic gets slowed down to a crawl and everyone's experience is very poor. Economically the most natural way to deal with, or better still prevent, congestion is to have higher prices for people who want to use the network at times of peak demand, and much lower prices when the network is likely to be quiet.

These higher / lower prices might be related to the time of day (eg free data between midnight and 06:00 each day), or to a reservation system in which you pay for priority space permanently or for a short time on the network, or to the type of traffic (eg voice calls get priority over data). There has also been a lot of heat, and little light, about "network neutrality" – whether mobile operators would favour their own services. Without going into detail, the way that the telecoms laws and regulations are set up in EU countries means this is pretty much a non-issue. The economics would say that a price-based approach gets to the most efficient use of the network –those who value it the most pay the most.

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"Free" is misleading

But life isn't that simple. For most of the noughties, mobile operators were trying to attract customers to start using data on their networks, which were fairly empty up till then. This led them to offer "unlimited" tariffs [apart from some small print about reasonable use] for a fixed monthly fee, which gave off the impression to customers that using bandwidth was "free" and limitless.

It also gave the same impression of "free bandwidth" to content deliverers, like YouTube, to device and mobile operating system providers, like Apple and Android, and to app developers, like mobile games. Because it was "free", nobody thought they had to worry about it. There was just no incentive to do so. Indeed, from around 2008, the only company that really worried about it and did all it could to overcome it, namely BlackBerry, got blown away in the marketplace by Apple and Samsung.

These (lack of) incentives have to change. As the networks have filled up, the operators have gradually changed their pricing models to introduce limits of different kinds. This in turn means that consumers are becoming more aware of usage caps and the potential of incurring "overage" charges. Indeed, the worry about going over one's limit can itself cause consumers to restrict their usage levels well below the cap itself – especially when most users do not have any familiarity with megabytes or gigabytes, and therefore no way of relating levels of consumption to actual usage volumes.

So what?

What the future of bandwidth means for the industry

Bringing together our analysis, we can point to some questions to be addressed by each of the main types of player in the mobile industry when they think about living with the opportunities and realities of mobile bandwidth. Note that we are constraining ourselves to questions relating to bandwidth, not to the overall business strategy.

Content and app providers

How do I best employ video?

How do I match the consumers' experience of my content / app to the bandwidth available and the particular type of mobile technology (4G, 3G, WiFi, etc) that the device is using at any particular moment? In particular, what is the most important part – the essence – of the experience, and how can I maintain that in all circumstances? Are there any circumstances in which I'd pay for my content / app to have preferential treatment of some kind, or is it a case that "quality doesn't matter" for my youthful audience of "digital natives"?

Advertisers

As with the content providers, how do I make sure I get my main message across in all circumstances?

How do I make sure I'm seen to add value to the consumer when they are paying to view the ad - as it is taking a chunk out of their monthly bandwidth limit?

Infrastructure vendors

How can I improve the efficiency in which the radio access technologies are used together and the efficiency of the backhaul that all these new 4G base stations will need?

How can I design my product (whether that be hardware or software) to give as much flexibility as possible to managing bandwidth in a proactive way, both long-term planning and instantaneous planning?

How can I attract, acquire and upscale the innovation from small companies in order to add more value to my offerings for bandwidth and its management?

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Device manufacturers and operating system developers

How do I best enable my users to engage with video?

How do I best manage the radio hardware, software and interface in the device to keep the best experience for my users?

How do I do all this without draining the battery too quickly?

Mobile operators and service providers

How can I avoid being like Sisyphus in the Greek myth – pushing my latest network technology investment rock uphill, then seeing the profits roll down the hill into others' pockets?

Will the underlying "true" economics prevail and will I have to start charging differentially for urban and rural usage (like in the fixed internet)?

How do I come up with pricing models and marketing messages that encourage my customers to consume more of my network – and still have a great mobile experience – rather than constraining themselves?

Game, Set and Match to bandwidth?

To finish where we started: Wimbledon Centre Court. It is now the afternoon of Sunday 7th July 2013 and Andy Murray is serving at match point to become Men's Singles Champion. A nation holds its breath. This time there are no Olympics-inspired extra-large mobile networks to make sure a great experience is delivered to all those millions of people following the tennis on high-density video on a smartphone or a tablet. Instead there are the networks built from wisely cautious investments by operators unsure of whether they will be the main beneficiaries of all the capital they spend. When the cheer of victory erupts, let's hope it is shared by all those staring at the match on a small screen.

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About the authors

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Moray Barclay is at his happiest trying to get traction on brand new projects in the fields of telecommunications and its adjacent industries. Over twenty years in industry, he managed to achieve this for about 50% of the time, and he is trying to increase that percentage as a freelancer.

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